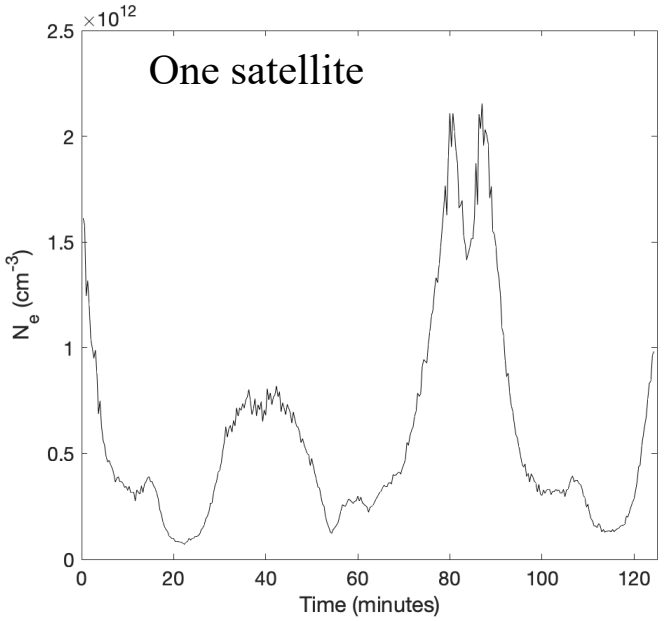
Gradient calculation techniques for multi-point ionosphere/thermosphere measurements from GDC

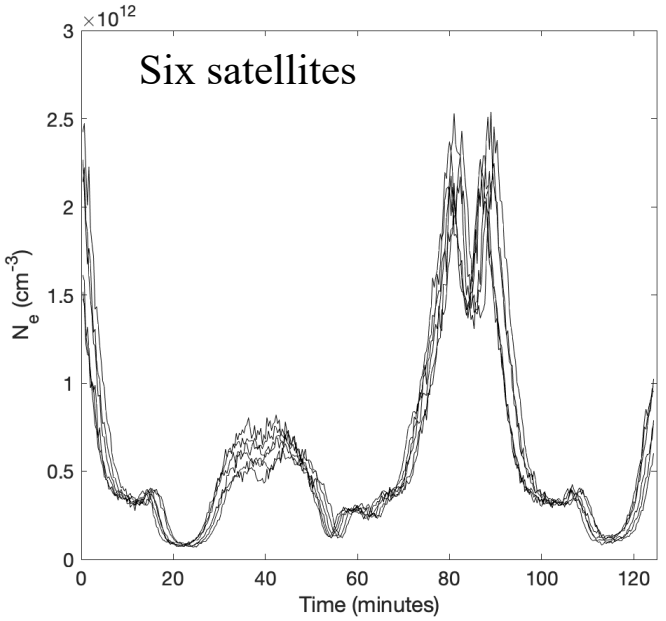
Hassanali Akbari [1,2,*], **Douglas Rowland** [1], **Austin Coleman** [3], **Anton Buynovskiy** [3] **and Jeffrey Thayer** [3,4]

[1] *NASA Goddard Space Flight Center, Greenbelt, MD, USA*
[2] *Department of Physics, Catholic University of America, Washington, DC, USA*
[3] *Ann and H.J. Smead Aerospace Engineering Sciences, University of Colorado at Boulder, CO, USA*
[4] *Space Weather Technology, Research, and Education Center (SWx TREC), University of Colorado at Boulder, CO, USA*

Calculating gradients… why?

Resolving spatiotemporal ambiguity in in-situ measurements is commonly raised as a major justification for multi-platform satellite missions.

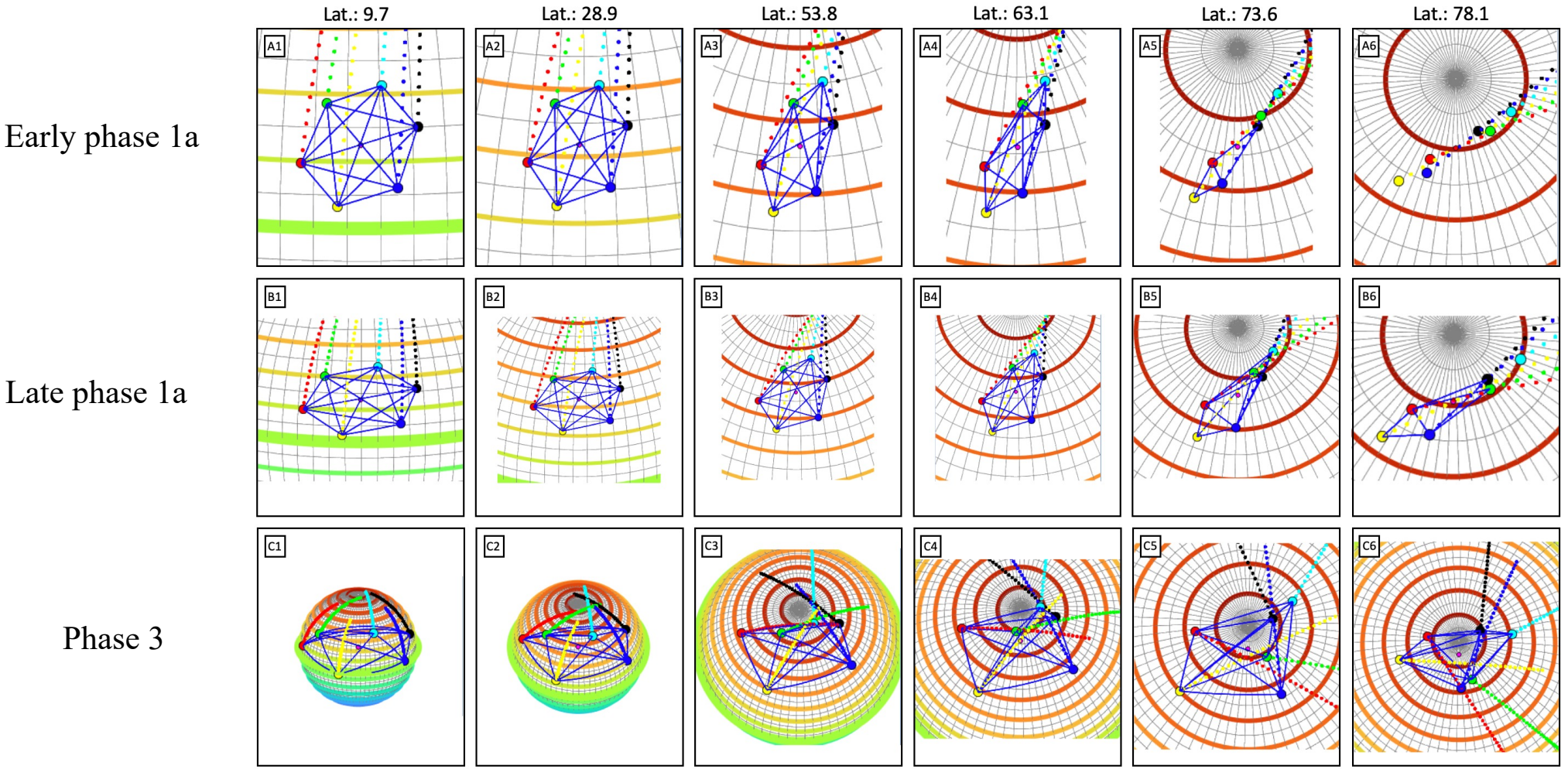




Mathematically, the problem can be translated to one involving calculation of gradients—once the gradients of a field are known with respect to space and time its local dynamics can be uniquely understood.

Calculating gradients… how?

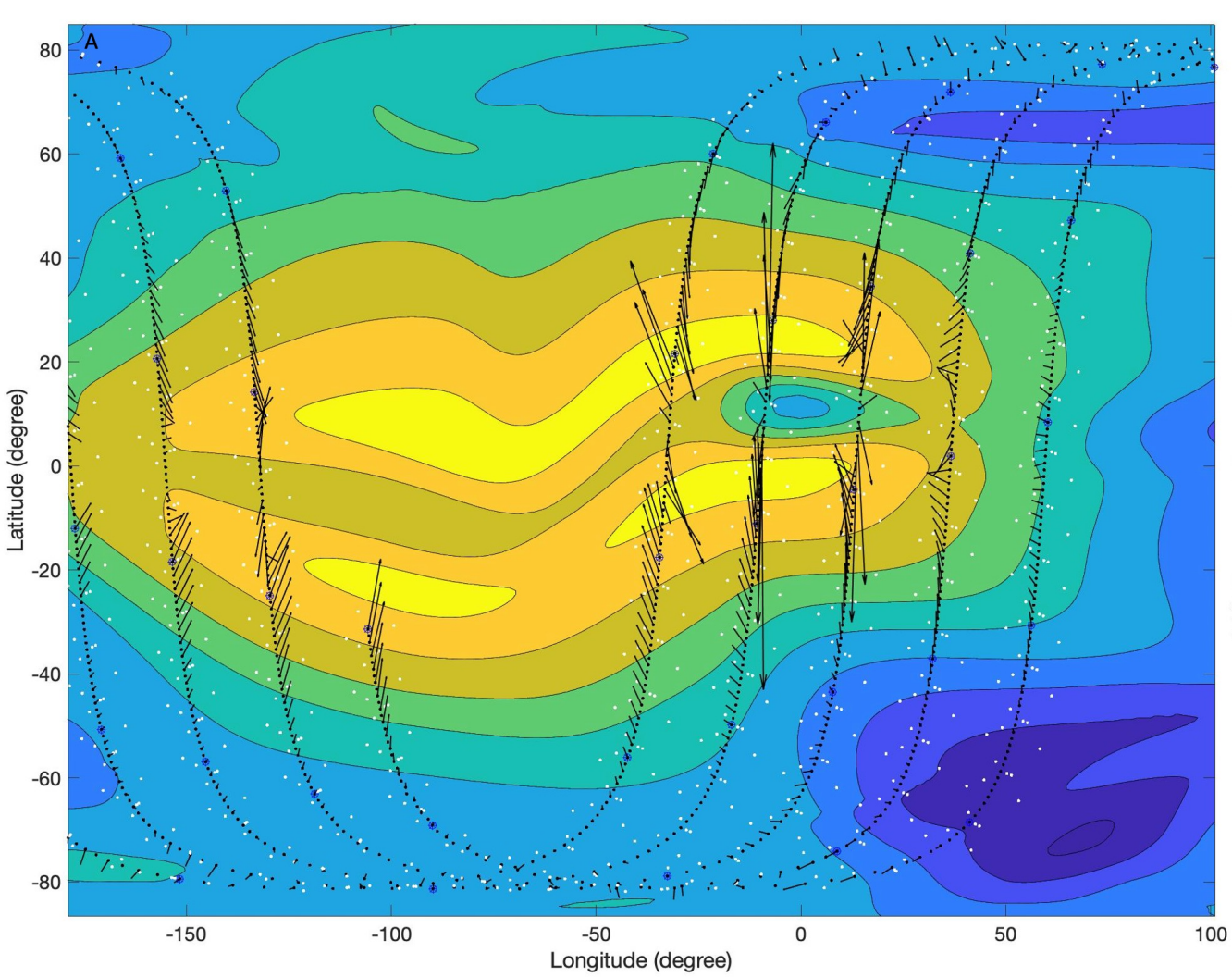
The gradient calculation approach needs to be highly flexible to be suitable for GDC's dynamic constellation.

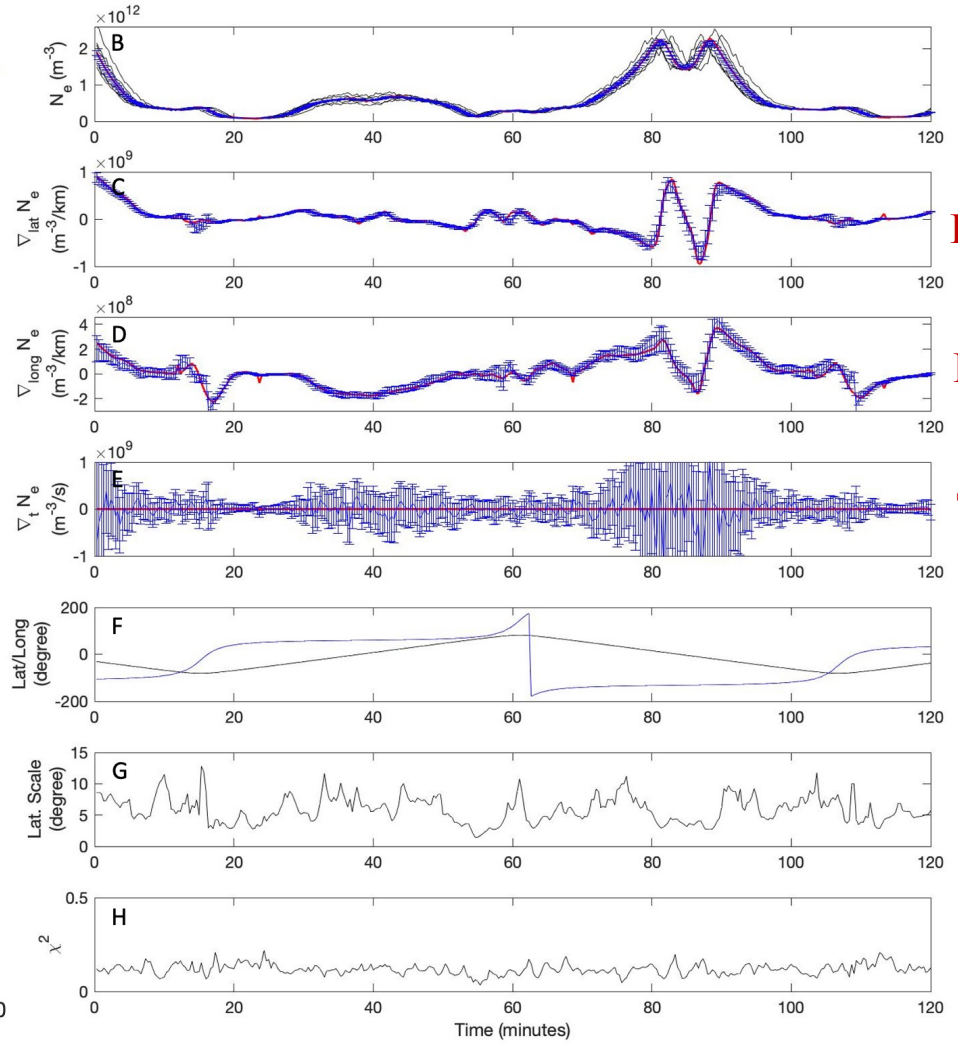


Least Squares Gradient Calculation with Adaptive Scaling
Based on De Keyser et a., 2007, 2008

Test---determining spatiotemporal variability of electron density

Electron density, from phase 1a: 4% added measurement noise, cadence 20 seconds, 2-min integration





Test---determining spatiotemporal variability of neutral wind

Neutral wind, from phase 1a: 1% added measurement noise, cadence 20 seconds, 3-min integration